<110> CIEPLAK, WITOLD

<120> PERTUSSIN TOXIN GENE: CLONING AND EXPRESSION OF
      PROTECTIVE ANTIGEN

<130> 2026-4253US7c

<140> 09/770,875
<141> 2001-01-26

<150> 07/311,612
<151> 1989-02-15

<150> 07/542,149
<151> 1990-06-22

<150> 08/483,326
<151> 1995-06-07

<150> 09/128,911
<151> 1998-08-04

<160> 28

<170> PatentIn Ver. 2.1

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cggcgcgatg acgcatcttt cccccgccct ggccgacgtt ccttatgtgc tggtgaagac 120
caatatggtg gtcaccagcg tagccatgaa gccgtatgaa gtcaccccga cgcggatgct 180
ggtc   184

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<211> 61
<212> PRT
<213> Bordetella pertussis

<400> 2
Pro Gly Gln Gly Gly Ala Arg Arg Ser Arg Val Arg Ala Leu Ala Trp
 1   5   10   15

Leu Leu Ala Ser Gly Ala Met Thr His Leu Ser Pro Ala Leu Ala Asp
          20   25   30

Val Pro Tyr Val Leu Val Lys Thr Asn Met Val Val Thr Ser Val Ala
          35   40   45

Met Lys Pro Tyr Glu Val Thr Pro Thr Arg Met Leu Val
     50   55   60

<210> 3
<211> 17
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<213> Bordetella pertussis

<220>
<223> Purine (P) R=G or A; Y=T or C; N=A, C, G, or T

<220>
<221> modified_base
<222> (6)

<220>
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<400> 3
atgaarccnt aygargt   17

<210> 4
<211> 30
<212> PRT
<213> Bordetella pertussis

<220>
<223> Xaa = Any amino acid; the 8th Val and 4th Pro are
      questionable.

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<222> (15)

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Asp Val Pro Tyr Val Leu Val Lys Thr Asn Met Val Val Thr Xaa Val
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Ala Met Lys Pro Tyr Glu Val Val Pro Pro Arg Met Leu Val
            20                  25                  30


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atcgtcctgc tcaaccgcca catcaacgag gcgctgcagt ccaaggcggt cgtcgaggcc 120

tttgccgccc aaggcgccac gccggtcatc gccacgccgg atcagacccg cggcttcatc 180

gcagacgaga tccagcgctg ggccggcgtc gtgcgcgaaa ccggcgccaa gctgaagtag 240

cagcgcagcc ctccaacgcg ccatccccgt ccggccggca ccatcccgca tacgtgttgg 300
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caaccgccaa cgcgcatgcg tgcagattcg tcgtacaaaa ccctcgattc ttccgtacat 360

cccgctactg caatccaaca cggcatgaac gctccttcgg cgcaaagtcg cgcgatggta 420

ccggtcaccg tccggaccgt gctgacccc ctgccatggt gtgatcccta aaataggcac 480

catcaaaacg cagaggggaa gacgggatgc gttgcactcg ggcaattcgc caaaccgcaa 540

gaacaggctg gctgacgtgg ctggcgattc ttgccgtcac ggcgcccgtg acttcgccgg 600

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catgggcc gac gat cct ccc gcc acc gta tac cgc tat gac tcc cgc ccg      650
         Asp Asp Pro Pro Ala Thr Val Tyr Arg Tyr Asp Ser Arg Pro
          1               5                   10
```

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ccg gag gac gtt ttc cag aac gga ttc acg gcg tgg gga aac aac gac      698
Pro Glu Asp Val Phe Gln Asn Gly Phe Thr Ala Trp Gly Asn Asn Asp
 15              20                  25                  30
```

```
aat gtg ctc gac cat ctg acc gga cgt tcc tgc cag gtc ggc agc agc      746
Asn Val Leu Asp His Leu Thr Gly Arg Ser Cys Gln Val Gly Ser Ser
             35                  40                  45
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aac agc gct ttc gtc tcc acc agc agc agc cgg cgc tat acc gag gtc      794
Asn Ser Ala Phe Val Ser Thr Ser Ser Ser Arg Arg Tyr Thr Glu Val
             50                  55                  60
```

```
tat ctc gaa cat cgc atg cag gaa gcg gtc gag gcc gaa cgc gcc ggc      842
Tyr Leu Glu His Arg Met Gln Glu Ala Val Glu Ala Glu Arg Ala Gly
             65                  70                  75
```

```
agg ggc acc ggc cac ttc atc ggc tac atc tac gaa gtc cgc gcc gac      890
Arg Gly Thr Gly His Phe Ile Gly Tyr Ile Tyr Glu Val Arg Ala Asp
     80                  85                  90
```

```
aac aat ttc tac ggc gcc gcc agc tcg tac ttc gaa tac gtc gac act      938
Asn Asn Phe Tyr Gly Ala Ala Ser Ser Tyr Phe Glu Tyr Val Asp Thr
 95                  100                 105                 110
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tat ggc gac aat gcc ggc cgt atc ctc gcc ggc gcg ctg gcc acc tac      986
Tyr Gly Asp Asn Ala Gly Arg Ile Leu Ala Gly Ala Leu Ala Thr Tyr
             115                 120                 125
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cag agc gaa tat ctg gca cac cgg cgc att ccg ccc gaa aac atc cgc     1034
Gln Ser Glu Tyr Leu Ala His Arg Arg Ile Pro Pro Glu Asn Ile Arg
             130                 135                 140
```

```
agg gta acg cgg gtc tat cac aac ggc atc acc ggc gag acc acg acc     1082
Arg Val Thr Arg Val Tyr His Asn Gly Ile Thr Gly Glu Thr Thr Thr
```

4

```
acg gag tat tcc aac gct cgc tac gtc agc cag cat act cgc gcc aat     1130
Thr Glu Tyr Ser Asn Ala Arg Tyr Val Ser Gln His Thr Arg Ala Asn
        160                 165                 170


ccc aac ccc tac aca tcg cga agg tcc gta gcg tcg atc gtc ggc aca     1178
Pro Asn Pro Tyr Thr Ser Arg Arg Ser Val Ala Ser Ile Val Gly Thr
175                 180                 185                 190


ttg gtg cgc atg gcg ccg gtg ata ggc gct tgc atg gcg cgg cag gcc     1226
Leu Val Arg Met Ala Pro Val Ile Gly Ala Cys Met Ala Arg Gln Ala
                195                 200                 205


gaa agc tcc gag gcc atg gca gcc tgg tcc gaa cgc gcc ggc gag gcg     1274
Glu Ser Ser Glu Ala Met Ala Ala Trp Ser Glu Arg Ala Gly Glu Ala
            210                 215                 220


atg gtt ctc gtg tac tac gaa agc atc gcg tat tcg ttctagacct         1320
Met Val Leu Val Tyr Tyr Glu Ser Ile Ala Tyr Ser
        225                 230


ggcccagccc cgcccaactc cggtaattca acagcatgcc gatcgaccgc aagacgctct 1380


gccatctcct gtccgttctg ccgttggccc tcctcggatc tcacgtggcg cgg gcc      1436
                                                            Ala
                                                            235


tcc acg cca ggc atc gtc att ccg ccg cag gaa cag att acc cag cat     1484
Ser Thr Pro Gly Ile Val Ile Pro Pro Gln Glu Gln Ile Thr Gln His
                240                 245                 250


ggc agc ccc tat gga cgc tgc gcg aac aag acc cgt gcc ctg acc gtg     1532
Gly Ser Pro Tyr Gly Arg Cys Ala Asn Lys Thr Arg Ala Leu Thr Val
                255                 260                 265


gcg gaa ttg cgc ggc agc ggc gat ctg cag gag tac ctg cgt cat gtg     1580
Ala Glu Leu Arg Gly Ser Gly Asp Leu Gln Glu Tyr Leu Arg His Val
            270                 275                 280


acg cgc ggc tgg tca ata ttt gcg ctc tac gat ggc acc tat ctc ggc     1628
Thr Arg Gly Trp Ser Ile Phe Ala Leu Tyr Asp Gly Thr Tyr Leu Gly
            285                 290                 295


ggc gaa tat ggc ggc gtg atc aag gac gga aca ccc ggc ggc gca ttc     1676
Gly Glu Tyr Gly Gly Val Ile Lys Asp Gly Thr Pro Gly Gly Ala Phe
300                 305                 310                 315
```

5

```
gac ctg aaa acg acg ttc tgc atc atg acc acg cgc aat acg ggt caa   1724
Asp Leu Lys Thr Thr Phe Cys Ile Met Thr Thr Arg Asn Thr Gly Gln
            320             325             330


ccc gca acg gat cac tac tac agc aac gtc acc gcc act cgc ctg ctc   1772
Pro Ala Thr Asp His Tyr Tyr Ser Asn Val Thr Ala Thr Arg Leu Leu
            335             340             345


tcc agc acc aac agc agg cta tgc gcg gtc ttc gtc aga agc ggg caa   1820
Ser Ser Thr Asn Ser Arg Leu Cys Ala Val Phe Val Arg Ser Gly Gln
            350             355             360


ccg gtc att ggc gcc tgc acc agc ccg tat gac ggc aag tac tgg agc   1868
Pro Val Ile Gly Ala Cys Thr Ser Pro Tyr Asp Gly Lys Tyr Trp Ser
    365             370             375


atg tac agc cgg ctg cgg aaa atg ctt tac ctg atc tac gtg gcc ggc   1916
Met Tyr Ser Arg Leu Arg Lys Met Leu Tyr Leu Ile Tyr Val Ala Gly
380             385             390             395


atc tcc gta cgc gtc cat gtc agc aag gaa gaa cag tat tac gac tat   1964
Ile Ser Val Arg Val His Val Ser Lys Glu Glu Gln Tyr Tyr Asp Tyr
            400             405             410


gag gac gca acg ttc gag act tac gcc ctt acc ggc atc tcc atc tgc   2012
Glu Asp Ala Thr Phe Glu Thr Tyr Ala Leu Thr Gly Ile Ser Ile Cys
            415             420             425


aat cct gga tca tcc tta tgctgagacg cttccccact cgaaccaccg          2060
Asn Pro Gly Ser Ser Leu
            430


ccccgggaca gggcggcgcc cggcggtcgc gcatgcgcgc cctggcgtgg ttgctggcat 2120


ccggcgcgat gacgcatctt tcccccgccc tg gcc gac gtt cct tat gtg ctg   2173
                                   Ala Asp Val Pro Tyr Val Leu
                                       435             440


gtg aag acc aat atg gtg gtc acc agc gta gcc atg aag ccg tat gaa   2221
Val Lys Thr Asn Met Val Val Thr Ser Val Ala Met Lys Pro Tyr Glu
            445             450             455


gtc acc ccg acg cgc atg ctg gtc tgc ggc atc gcc gcc aaa ctg ggc   2269
Val Thr Pro Thr Arg Met Leu Val Cys Gly Ile Ala Ala Lys Leu Gly
            460             465             470


gcc gcg gcc agc agc ccg gac gcg cac gtg ccg ttc tgc ttc ggc aag   2317
Ala Ala Ala Ser Ser Pro Asp Ala His Val Pro Phe Cys Phe Gly Lys
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6

```
gat ctc aag cgt ccc ggc agc agt ccc atg gaa gtc atg ttg cgc gcc   2365
Asp Leu Lys Arg Pro Gly Ser Ser Pro Met Glu Val Met Leu Arg Ala
    490                 495                 500


gtc ttc atg caa caa cgg ccg ctg cgc atg ttt ctg ggt ccc aag caa   2413
Val Phe Met Gln Gln Arg Pro Leu Arg Met Phe Leu Gly Pro Lys Gln
505                 510                 515                 520


ctc act ttc gaa ggc aag ccc gcg ctc gaa ctg atc cgg atg gtc gaa   2461
Leu Thr Phe Glu Gly Lys Pro Ala Leu Glu Leu Ile Arg Met Val Glu
                525                 530                 535


tgc agc ggc aag cag gat tgc ccctgaaggc gaaccccatg cataccatcg      2512
Cys Ser Gly Lys Gln Asp Cys
                540


catccatcct gttgtccgtg ctcggcatat acagcccggc tgac gtc gcc ggc ttg  2568
                                                   Val Ala Gly Leu
                                                        545


ccg acc cat ctg tac aag aac ttc act gtc cag gag ctg gcc ttg aaa   2616
Pro Thr His Leu Tyr Lys Asn Phe Thr Val Gln Glu Leu Ala Leu Lys
        550                 555                 560


ctg aag ggc aag aat cag gag ttc tgc ctg acc gcc ttc atg tcg ggc   2664
Leu Lys Gly Lys Asn Gln Glu Phe Cys Leu Thr Ala Phe Met Ser Gly
        565                 570                 575


aga agc ctg gtc cgg gcg tgc ctg tcc gac gcg gga cac gag cac gac   2712
Arg Ser Leu Val Arg Ala Cys Leu Ser Asp Ala Gly His Glu His Asp
580                 585                 590                 595


acg tgg ttc gac acc atg ctt ggc ttt gcc ata tcc gcg tat gcg ctc   2760
Thr Trp Phe Asp Thr Met Leu Gly Phe Ala Ile Ser Ala Tyr Ala Leu
                600                 605                 610


aag agc cgg atc gcg ctg acg gtg gaa gac tcg ccg tat ccg ggc act   2808
Lys Ser Arg Ile Ala Leu Thr Val Glu Asp Ser Pro Tyr Pro Gly Thr
                615                 620                 625


ccc ggc gat ctg ctc gaa ctg cag atc tgc ccg ctc aac gga tat tgc   2856
Pro Gly Asp Leu Leu Glu Leu Gln Ile Cys Pro Leu Asn Gly Tyr Cys
        630                 635                 640


gaatgaaccc ttccggaggt ttcgacgttt ccgcgcaatc cgcttgagac gatcttccgc 2916
```

cctggttcca ttccgggaac accgcaacat gctgatcaac aacaagaagc tgcttcatca 2976

cattctgccc atcctggtgc tcgccctgct gggcatgcgc acggcccag gcc gtt gcg 3034
                                                          Ala Val Ala
                                                              645

cca ggc atc gtc atc ccg ccg aag gca ctg ttc acc caa cag ggc ggc   3082
Pro Gly Ile Val Ile Pro Pro Lys Ala Leu Phe Thr Gln Gln Gly Gly
            650   655   660

gcc tat gga cgc tgc ccg aac gga acc cgc gcc ttg acc gtg gcc gaa   3130
Ala Tyr Gly Arg Cys Pro Asn Gly Thr Arg Ala Leu Thr Val Ala Glu
            665   670   675

ctg cgc ggc aac gcc gaa ttg cag acg tat ttg cgc cag ata acg ccc   3178
Leu Arg Gly Asn Ala Glu Leu Gln Thr Tyr Leu Arg Gln Ile Thr Pro
        680   685   690

ggc tgg tcc ata tac ggt ctc tat gac ggt acg tac ctg ggc cag gcg   3226
Gly Trp Ser Ile Tyr Gly Leu Tyr Asp Gly Thr Tyr Leu Gly Gln Ala
695   700   705   710

tac ggc ggc atc atc aag gac gcg ccg cca ggc gcg ggg ttc att tat   3274
Tyr Gly Gly Ile Ile Lys Asp Ala Pro Pro Gly Ala Gly Phe Ile Tyr
                715   720   725

cgc gaa act ttc tgc atc acg acc ata tac aag acc ggg caa ccg gct   3322
Arg Glu Thr Phe Cys Ile Thr Thr Ile Tyr Lys Thr Gly Gln Pro Ala
                730   735   740

gcg gat cac tac tac agc aag gtc acg gcc acg cgc ctg ctc gcc agc   3370
Ala Asp His Tyr Tyr Ser Lys Val Thr Ala Thr Arg Leu Leu Ala Ser
            745   750   755

acc aac agc agg ctg tgc gcg gta ttc gtc agg gac ggg caa tcg gtc   3418
Thr Asn Ser Arg Leu Cys Ala Val Phe Val Arg Asp Gly Gln Ser Val
            760   765   770

atc gga gcc tgc gcc agc ccg tat gaa ggc agg tac aga gac atg tac   3466
Ile Gly Ala Cys Ala Ser Pro Tyr Glu Gly Arg Tyr Arg Asp Met Tyr
775   780   785   790

gac gcg ctg cgg cgc ctg ctg tac atg atc tat atg tcc ggc ctt gcc   3514
Asp Ala Leu Arg Arg Leu Leu Tyr Met Ile Tyr Met Ser Gly Leu Ala
                795   800   805

gta cgc gtc cac gtc agc aag gaa gag cag tat tac gac tac gag gac   3562
Val Arg Val His Val Ser Lys Glu Glu Gln Tyr Tyr Asp Tyr Glu Asp

8

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gcc aca ttc cag acc tat gcc ctc acc ggc att tcc ctc tgc aac ccg   3610
Ala Thr Phe Gln Thr Tyr Ala Leu Thr Gly Ile Ser Leu Cys Asn Pro
        825                      830                      835

gca gcg tcg ata tgctgagccg ccggctcgga tctgttcgcc tgtccatgtt      3662
Ala Ala Ser Ile
    840
```

tttccttgac ggataccgcg aatgaatccc ttgaaagact tgagagcatc gctaccgcgc 3722

ctggccttca tggcagcctg caccctgttg tccgccacgc tgcccgacct cgcccaggcc 3782

ggcggcgggc tgcagcgctg tcaaccactt catggcgacg atcgtggtcg tactgccgcg 3842

gcggtcagtg gccacggtga ccatcgccat aatctgggcg ggctacaagc tgctgttccg 3902

gcacgccgat gtgctggacg tggtgcgtgt ggtgctggcg ggagctgctg atcggcgcat 3962

cggccgaaat cgctcgttat ctgctgacct gaatcctgga cgtatcgaac atgcgtgatc 4022

cgcttttcaa gggctgcacc cggcgccgcg atgctgatgg cgtacccgcc acggcaggcc 4082

gtgtgcagcc ggcaccattc cctgctgggc catctcggtt cagcatccgc tttctggcct 4142

tgtttcccgt ggcattgctg gcgatgcgga tcatgatccg gcgcgatgac cagcagttcc 4202

gcctgatc   4210

<210> 6
<211> 234
<212> PRT
<213> Bordetella pertussis

<400> 6
Asp Asp Pro Pro Ala Thr Val Tyr Arg Tyr Asp Ser Arg Pro Pro Glu
  1   5   10   15
Asp Val Phe Gln Asn Gly Phe Thr Ala Trp Gly Asn Asn Asp Asn Val
            20   25   30
Leu Asp His Leu Thr Gly Arg Ser Cys Gln Val Gly Ser Ser Asn Ser
            35   40   45
Ala Phe Val Ser Thr Ser Ser Arg Arg Tyr Thr Glu Val Tyr Leu
        50   55   60
Glu His Arg Met Gln Glu Ala Val Glu Ala Glu Arg Ala Gly Arg Gly
 65   70   75   80
Thr Gly His Phe Ile Gly Tyr Ile Tyr Glu Val Arg Ala Asp Asn Asn
```

```
                      85                      90                      95
Phe Tyr Gly Ala Ala Ser Ser Tyr Phe Glu Tyr Val Asp Thr Tyr Gly
                     100                     105                     110
Asp Asn Ala Gly Arg Ile Leu Ala Gly Ala Leu Ala Thr Tyr Gln Ser
                     115                     120                     125
Glu Tyr Leu Ala His Arg Arg Ile Pro Pro Glu Asn Ile Arg Arg Val
                     130                     135                     140
Thr Arg Val Tyr His Asn Gly Ile Thr Gly Glu Thr Thr Thr Thr Glu
145                     150                     155                     160
Tyr Ser Asn Ala Arg Tyr Val Ser Gln His Thr Arg Ala Asn Pro Asn
                     165                     170                     175
Pro Tyr Thr Ser Arg Arg Ser Val Ala Ser Ile Val Gly Thr Leu Val
                     180                     185                     190
Arg Met Ala Pro Val Ile Gly Ala Cys Met Ala Arg Gln Ala Glu Ser
                     195                     200                     205
Ser Glu Ala Met Ala Ala Trp Ser Glu Arg Ala Gly Glu Ala Met Val
                     210                     215                     220
Leu Val Tyr Tyr Glu Ser Ile Ala Tyr Ser
225                     230
```

```
<210> 7
<211> 199
<212> PRT
<213> Bordetella pertussis
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```
<400> 7
Ala Ser Thr Pro Gly Ile Val Ile Pro Pro Gln Glu Gln Ile Thr Gln
  1               5                      10                      15
His Gly Ser Pro Tyr Gly Arg Cys Ala Asn Lys Thr Arg Ala Leu Thr
                     20                      25                      30
Val Ala Glu Leu Arg Gly Ser Gly Asp Leu Gln Glu Tyr Leu Arg His
                     35                      40                      45
Val Thr Arg Gly Trp Ser Ile Phe Ala Leu Tyr Asp Gly Thr Tyr Leu
                     50                      55                      60
Gly Gly Glu Tyr Gly Gly Val Ile Lys Asp Gly Thr Pro Gly Gly Ala
65                      70                      75                      80
Phe Asp Leu Lys Thr Thr Phe Cys Ile Met Thr Thr Arg Asn Thr Gly
                     85                      90                      95
Gln Pro Ala Thr Asp His Tyr Tyr Ser Asn Val Thr Ala Thr Arg Leu
                     100                     105                     110
Leu Ser Ser Thr Asn Ser Arg Leu Cys Ala Val Phe Val Arg Ser Gly
                     115                     120                     125
Gln Pro Val Ile Gly Ala Cys Thr Ser Pro Tyr Asp Gly Lys Tyr Trp
                     130                     135                     140
Ser Met Tyr Ser Arg Leu Arg Lys Met Leu Tyr Leu Ile Tyr Val Ala
145                     150                     155                     160
Gly Ile Ser Val Arg Val His Val Ser Lys Glu Glu Gln Tyr Tyr Asp
```

10

```
                    165                     170                     175
Tyr Glu Asp Ala Thr Phe Glu Thr Tyr Ala Leu Thr Gly Ile Ser Ile
                180                     185                     190
Cys Asn Pro Gly Ser Ser Leu
            195


<210> 8
<211> 110
<212> PRT
<213> Bordetella pertussis

<400> 8
Ala Asp Val Pro Tyr Val Leu Val Lys Thr Asn Met Val Val Thr Ser
  1               5                   10                  15
Val Ala Met Lys Pro Tyr Glu Val Thr Pro Thr Arg Met Leu Val Cys
                20                  25                  30
Gly Ile Ala Ala Lys Leu Gly Ala Ala Ala Ser Ser Pro Asp Ala His
            35                  40                  45
Val Pro Phe Cys Phe Gly Lys Asp Leu Lys Arg Pro Gly Ser Ser Pro
        50                  55                  60
Met Glu Val Met Leu Arg Ala Val Phe Met Gln Gln Arg Pro Leu Arg
 65                 70                  75                  80
Met Phe Leu Gly Pro Lys Gln Leu Thr Phe Glu Gly Lys Pro Ala Leu
                85                  90                  95
Glu Leu Ile Arg Met Val Glu Cys Ser Gly Lys Gln Asp Cys
                100                 105                 110


<210> 9
<211> 100
<212> PRT
<213> Bordetella pertussis

<400> 9
Val Ala Gly Leu Pro Thr His Leu Tyr Lys Asn Phe Thr Val Gln Glu
  1               5                   10                  15
Leu Ala Leu Lys Leu Lys Gly Lys Asn Gln Glu Phe Cys Leu Thr Ala
                20                  25                  30
Phe Met Ser Gly Arg Ser Leu Val Arg Ala Cys Leu Ser Asp Ala Gly
            35                  40                  45
His Glu His Asp Thr Trp Phe Asp Thr Met Leu Gly Phe Ala Ile Ser
        50                  55                  60
Ala Tyr Ala Leu Lys Ser Arg Ile Ala Leu Thr Val Glu Asp Ser Pro
 65                 70                  75                  80
Tyr Pro Gly Thr Pro Gly Asp Leu Leu Glu Leu Gln Ile Cys Pro Leu
                85                  90                  95
Asn Gly Tyr Cys
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100

<210> 10
<211> 199
<212> PRT
<213> Bordetella pertussis

<400> 10
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Ala Val Ala Pro Gly Ile Val Ile Pro Pro Lys Ala Leu Phe Thr Gln
 1               5                  10                  15
Gln Gly Gly Ala Tyr Gly Arg Cys Pro Asn Gly Thr Arg Ala Leu Thr
              20                  25                  30
Val Ala Glu Leu Arg Gly Asn Ala Glu Leu Gln Thr Tyr Leu Arg Gln
          35                  40                  45
Ile Thr Pro Gly Trp Ser Ile Tyr Gly Leu Tyr Asp Gly Thr Tyr Leu
          50                  55                  60
Gly Gln Ala Tyr Gly Gly Ile Ile Lys Asp Ala Pro Pro Gly Ala Gly
 65                  70                  75                  80
Phe Ile Tyr Arg Glu Thr Phe Cys Ile Thr Thr Ile Tyr Lys Thr Gly
              85                  90                  95
Gln Pro Ala Ala Asp His Tyr Tyr Ser Lys Val Thr Ala Thr Arg Leu
             100                 105                 110
Leu Ala Ser Thr Asn Ser Arg Leu Cys Ala Val Phe Val Arg Asp Gly
             115                 120                 125
Gln Ser Val Ile Gly Ala Cys Ala Ser Pro Tyr Glu Gly Arg Tyr Arg
         130                 135                 140
Asp Met Tyr Asp Ala Leu Arg Arg Leu Leu Tyr Met Ile Tyr Met Ser
145                 150                 155                 160
Gly Leu Ala Val Arg Val His Val Ser Lys Glu Glu Gln Tyr Tyr Asp
                 165                 170                 175
Tyr Glu Asp Ala Thr Phe Gln Thr Tyr Ala Leu Thr Gly Ile Ser Leu
             180                 185                 190
Cys Asn Pro Ala Ala Ser Ile
             195
```

<210> 11
<211> 976
<212> PRT
<213> Bordetella pertussis

<400> 11
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Met Arg Cys Thr Arg Ala Ile Arg Gln Thr Ala Arg Thr Gly Trp Leu
 1               5                  10                  15

Thr Trp Leu Ala Ile Leu Ala Val Thr Ala Pro Val Thr Ser Pro Ala
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12

Trp Ala Asp Asp Pro Pro Ala Thr Val Tyr Arg Tyr Asp Ser Arg Pro
        35   40   45

Pro Glu Asp Val Phe Gln Asn Gly Phe Thr Ala Trp Gly Asn Asn Asp
        50   55   60

Asn Val Leu Asp His Leu Thr Gly Arg Ser Cys Gln Val Gly Ser Ser
65   70   75   80

Asn Ser Ala Phe Val Ser Thr Ser Ser Ser Arg Arg Tyr Thr Glu Val
                85   90   95

Tyr Leu Glu His Arg Met Gln Glu Ala Val Glu Ala Glu Arg Ala Gly
            100   105   110

Arg Gly Thr Gly His Phe Ile Gly Tyr Ile Tyr Glu Val Arg Ala Asp
        115   120   125

Asn Asn Phe Tyr Gly Ala Ala Ser Ser Tyr Phe Glu Tyr Val Asp Thr
        130   135   140

Tyr Gly Asp Asn Ala Gly Arg Ile Leu Ala Gly Ala Leu Ala Thr Tyr
145   150   155   160

Gln Ser Glu Tyr Leu Ala His Arg Arg Ile Pro Pro Glu Asn Ile Arg
                165   170   175

Arg Val Thr Arg Val Tyr His His Gly Ile Thr Gly Glu Thr Thr Thr
            180   185   190

Thr Glu Tyr Ser Asn Ala Arg Tyr Val Ser Gln Gln Thr Arg Ala Asn
            195   200   205

Pro Asn Pro Tyr Thr Ser Arg Arg Ser Val Ala Ser Ile Val Gly Thr
        210   215   220

Leu Val Arg Met Ala Pro Val Ile Ser Ala Cys Met Ala Arg Gln Ala
225   230   235   240

Glu Ser Ser Glu Ala Met Ala Ala Trp Ser Glu Arg Ala Gly Glu Ala
                245   250   255

Met Val Leu Val Tyr Tyr Glu Ser Ile Ala Tyr Ser Phe Val Met Pro
        260   265   270

Ile Asp Arg Lys Thr Leu Cys His Leu Leu Ser Val Leu Pro Leu Ala

Leu Leu Gly Ser His Val Ala Arg Ala Ser Thr Pro Gly Ile Val Ile
    290   295   300

Pro Pro Gln Glu Gln Ile Thr Gln His Gly Ser Pro Tyr Gly Arg Cys
305   310   315   320

Ala Asn Lys Thr Arg Ala Leu Thr Val Ala Glu Leu Arg Gly Ser Gly
                325   330   335

Asp Leu Gln Glu Tyr Leu Arg His Val Thr Arg Gly Trp Ser Ile Phe
                340   345   350

Ala Leu Tyr Asp Gly Thr Tyr Leu Gly Gly Glu Tyr Gly Gly Val Ile
                355   360   365

Lys Asp Gly Thr Pro Gly Gly Ala Phe Asp Leu Lys Thr Thr Phe Cys
    370   375   380

Ile Met Thr Thr Ala His Thr Gly Gln Pro Ala Thr Asp His Val Tyr
385   390   395   400

Ser His Val Thr Ala Thr Arg Leu Leu Ser Ser Thr His Ser Arg Leu
                405   410   415

Cys Ala Val Phe Val Arg Ser Gly Gln Pro Val Ile Gly Ala Cys Thr
                420   425   430

Ser Pro Tyr Asp Gly Lys Tyr Trp Ser His Tyr Ser Arg Leu Arg Lys
                435   440   445

Met Leu Tyr Leu Ile Tyr Val Ala Gly Ile Ser Val Arg Val His Val
    450   455   460

Ser Lys Glu Glu Gln Tyr Tyr Asp Tyr Glu Asp Ala Thr Phe Glu Thr
465   470   475   480

Tyr Ala Leu Thr Gly Ile Ser Ile Cys His Pro Gly Ser Ser Leu Cys
                485   490   495

Val Ala Trp Leu Leu Ala Ser Gly Ala Met Thr His Leu Ser Pro Ala
                500   505   510

Leu Ala Asp Val Pro Tyr Val Leu Val Lys Thr His His Val Val Thr
                515   520   525

Ser Val Ala His Lys Pro Val Glu Val Thr Pro Thr Arg Met Leu Val

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Cys Gly Ile Ala Ala Lys Leu Gly Ala Ala Ala Ser Ser Pro Asp Ala
545   550   555   560

His Val Pro Phe Cys Phe Gly Lys Asp Leu Lys Arg Pro Gly Ser Ser
                  565   570   575

Pro His Glu Val Met Leu Arg Ala Val Phe Met Gln Gln Arg Pro Leu
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Arg Met Phe Leu Gly Pro Lys Gln Leu Thr Phe Glu Gly Lys Pro Ala
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Leu Glu Leu Ile Arg Met Val Glu Cys Ser Gly Lys Gln Asp Cys Pro
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Val Phe Met His Thr Ile Ala Ser Ile Leu Leu Ser Val Leu Gly Ile
625   630   635   640

Tyr Ser Pro Ala Asp Val Ala Gly Leu Pro Thr His Leu Tyr Lys Asn
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Phe Thr Val Gln Glu Leu Ala Leu Lys Leu Lys Gly Lys Asn Gln Glu
              660   665   670

Phe Cys Leu Thr Ala Phe His Ser Gly Arg Ser Leu Val Arg Ala Cys
              675   680   685

Leu Ser Asp Ala Gly His Glu His Asp Thr Trp Phe Asp Thr Met Leu
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Gly Phe Ala Ile Ser Ala Tyr Ala Leu Lys Ser Arg Ile Ala Leu Thr
705   710   715   720

Val Glu Asp Ser Pro Tyr Pro Gly Thr Pro Gly Asp Leu Leu Glu Leu
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Gln Ile Cys Pro Leu Asn Gly Tyr Cys Glu Val Phe Met Leu Ile Asn
              740   745   750

Asn Lys Lys Leu Leu His His Ile Leu Pro Ile Leu Val Leu Ala Leu
              755   760   765

Leu Gly Met Arg Thr Ala Gln Ala Val Ala Pro Gly Ile Val Ile Pro
    770   775   780

Pro Lys Ala Leu Phe Thr Gln Gln Gly Gly Ala Tyr Gly Arg Cys Pro

Asn Gly Thr Arg Ala Leu Thr Val Ala Glu Leu Arg Gly Asn Ala Glu
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Leu Gln Thr Tyr Leu Arg Gln Ile Thr Pro Gly Trp Ser Ile Tyr Gly
                820   825   830

Leu Tyr Asp Gly Thr Tyr Leu Gly Gln Ala Tyr Gly Gly Ile Ile Lys
                835   840   845

Asp Ala Pro Pro Gly Ala Gly Phe Ile Tyr Arg Glu Thr Phe Cys Ile
        850   855   860

Thr Thr Ile Tyr Lys Thr Gly Gln Pro Ala Ala Asp His Tyr Tyr Ser
865   870   875   880

Lys Val Thr Ala Thr Arg Leu Leu Ala Ser Thr Asn Ser Arg Leu Cys
                885   890   895

Ala Val Phe Val Arg Asp Gly Gln Ser Val Ile Gly Ala Cys Ala Ser
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Pro Tyr Glu Gly Arg Tyr Arg Asp His Tyr Asp Ala Leu Arg Arg Leu
        915   920   925

Leu Tyr Met Ile Tyr Met Ser Gly Leu Ala Val Arg Val His Val Ser
        930   935   940

Lys Glu Glu Gln Tyr Tyr Asp Tyr Glu Asp Ala Thr Phe Gln Thr Tyr
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Ala Leu Thr Gly Ile Ser Leu Cys Asn Pro Ala Ala Ser Ile Cys Val
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